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A Final Technical Report on

Memory-based Expert Systems

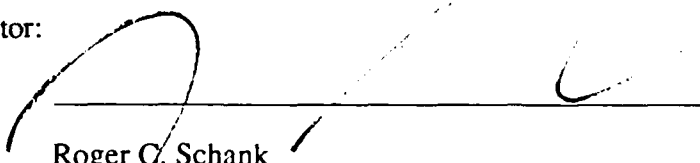
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Summary Report of Technical Progress

The purpose of this project was to explore new possibilities for representation and retrieval of knowledge. Building on our work in knowledge representation and memory organization, we built alternatives to the rule-based approach to expert systems. We tried instead to model the powerful capacity people have to generalize their knowledge across numerous domains. We believe that our exploration in this area will lead to flexible and robust methods for creating automated reasoning and problem-solving systems.

We refined our previous work on case-based planning theories in the areas of representation, adaptation strategies, and search & retrieval. Several researchers worked independently on projects that build a generalized prototype that simulates human *expertise*.

Eric Domeshek has completed design and begun implementation on a new version of the case-based advising system, ABBY. The major change in this version is the way in which it controls inference by appeal to expectations generated from the contents of the case-base. We have begun to explore massively parallel algorithms for both inference control and reminding. This version of ABBY also includes a new graphical user interface which allows easier input on new cases and clearer presentation of internal representations.

Chris Owens has continued his work in the area of memory-based and case-based reasoning. We are addressing two issues related to the problem of enabling a system to solve new problems by recalling either specific prior experiences or generalized knowledge structures.

The first issue is one of representation. How should a planning system characterize the situations it encounters? Some kinds of abstract characterizations, for example: "Plan failed because some critical resource was in short supply" or "Plan failed because I underestimated the significance of some condition" are useful ways to describe situations to which some common indexing vocabulary that can be used to organize a memory of descriptions of prior problem-solving episodes. Owens' dissertation, expected to be complete in December of 1989, contains an extended typology of these characterizations.

The second issue involves the mechanics of search and retrieval. The fundamental idea behind this research is that the contents of memory should play a more active role in driving the search and retrieval process. If the job of a system is to find a case in memory that most closely matches the current problem that the system is trying to solve, then the amount that the system needs to know about the current situation depends upon the range and scope of cases in memory against which it is trying to compare the current situation. We are continuing to explore the use of parallel architectures to address this problem. The ANON program, which runs on the Connection Machine parallel processor, demonstrates this approach.

Alex Kass has been working on how a machine can develop creative hypotheses by adapting the explanations that are stored in its memory to new situations. Kass has developed a catalog of approximately twenty adaptation strategies, and a mechanism for selecting between them. This library of adaptation strategies can be divided into three

major categories; strategies that generalize explanations; strategies that add detail to explanations, and strategies that build variations at the same level of detail.

Eric Jones has continued his work on *Brainstormer*, a program that uses proverbs to generate creative solutions to planning problems. *Brainstormer* comes up with suggestions for solving terrorist crises and for avoiding similar crises in the future. *Brainstormer* has two top-level modules--a planner and an adapter. The planner is responsible for suggesting solutions for terrorist crises. The adapter uses proverbs to advise the planner. *Brainstormer* now generates solutions from a number of proverbs.

Publications and Talks

Books:

Schank, Roger, *That Reminds Me of a Story*, Macmillan & Co., in press.

Schank, Roger, *The Creative Attitude*, with Peter Childers, Macmillan & Co., New York 1988.

Schank, Roger and Riesbeck, Chris, *Inside Case-based Reasoning*, Lawrence Erlbaum Associates, Hillside, NJ, 1989.

Papers:

Schank, Roger C. and Leake, David B., "Creativity and Learning in a Case-Based Explainer," forthcoming in *Artificial Intelligence* 40, 1989.

Owens, Christopher, "Plan Transformations as Abstract Indices," Proceedings of the Second Workshop on Case-Based Reasoning, DARPA, Pensacola, FL, May 1989.

Owens, Christopher, "Integrating Feature Extraction and Memory Search," Proceedings of the Eleventh Annual Conference of the Cognitive Science Society, August 1989.

Schank, Roger and Edelson, Daniel, "A Role for AI in Education: Using Technology to Reshape Education," *Journal of Artificial Intelligence in Education*.

Schank, Roger and Riesbeck, Christopher K., "From Training to Teaching: Techniques for Creative ITS," at the Second Intelligent Tutoring Systems Research Forum, sponsored by the Air Force Systems Command, April, 1989, San Antonio, TX.

Domeshek, Eric, "Parallelism for Index Generation and Reminding," Proceedings of the Second Workshop on Case-based Reasoning, DARPA, Pensacola, FL, May, 1989, and an abstract appearing in Workshop Proceedings published by Morgan Kaufmann.

Jones, Eric, "Case-based Analogical Reasoning Using Proverbs." Poster presented at the Case-Based Reasoning Workshop, Pensacola Beach, FL, May, 1989. Abstract in Workshop Proceedings published by Morgan Kaufmann.

Presentations:

Schank, Roger, AISIC Conference, March, 1989.

Schank, Roger, AI Education Conference, Amsterdam, May, 1989.

Domeshek, Eric, "Organizing a Large memory for Case-based Reasoning: A Case Study," presented at the Computer Science Liaison Program at Yale University, October, 1988.